PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Tubeless Tire

We, SEIBERLING RUBBER COMPANY, a Corporation organized and existing under the Laws of the State of Delaware, United States of America, of 345-15th Street, N.W., Barberton, State of Ohio, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a pneumatic tire designed for use on a rim without a a tube. There is incorporated in the tire a striation of platelets of mica and/or aluminum in sufficient concentration to impede the passage of air through the tire. The platelets are preferably present in a liner which forms the inner wall of the tire. They may be present in the coating on the fabric incorporated in the tire. This fabric may extend from bead to bead in the tire, as do the plies; or the fabric may be localized in the tire, as for instance the chafer strip which is located at the heels of the beads.

Pneumatic tires as manufactured in the past are quite permeable to the passage of air. In the tubeless tires now coming into the market, a liner of butyl rubber or other highly impermeable vulcanizate is applied to the inner surface of the tire.

According to this invention striations of platelets of mica and/or aluminum are embedded in the vulcanizate sufficiently close together to materially lessen the permeability of the tire to air. The preferred material is mica.

The size of the platelets has little influence on their effectiveness; both larger and smaller platelets having been tested, as will be more fully explained in what follows. If the platelets are fragile they must be sufficiently small so that when the tire is flexed in use their effectiveness is not destroyed by their disintegration. However, as will be evident from the tests referred to, mica, even though of a very fine particle size such as would be produced by the fracture of larger mica particles, is substantially as effective as the larger particles in reducing air permeability. The concentration of the particles is such as to produce a striation with overlapping which forms a barrier toward the passage of air.

The nature of the hydrocarbon affects the permeability of the tire, and particularly the permeability of the zone or ply of the vulcanizate in which the platelets are striated. For example, natural rubber has a much higher permeability than butyl rubber. The quantity of platelet material required to produce a certain impermeability will depend to a large extent upon the nature of the hydrocarbon in which it is striated and also upon the various materials which are compounded with the hydrocarbon.

Although the invention relates to the use of striated platelets in tubeless tires, the permeability of such tires to air also depends upon their design and structure, such as the number of plies, the structure of the tire at and around the bead where wicking of air through fabric plies may give difficulty, etc. The effect of the mica and/or aluminum platelet material is therefore best determined by comparative laboratory tests in which factors other than those being studied are largely eliminated. Therefore, the effect produced by the platelet material will be considered first in connection with such tests.

Commercial tubeless tires have been formed with liners of butyl rubber or a mixture of natural rubber and butyl rubber reclaim. This is because butyl rubber and the butyl rubber reclaim have low air permeability. The use of striated

[Price 3/-]

platelets decreases the permeability of these less permeable rubbers. What is more important, the reduction in permeability produced by striated platelet materials makes the use of more permeable rubbers commercially feasible for liners, etc., in tubeless tires.

In the following table we record the effect of mica and also different amounts of mica in various rubbers. The mica employed was a standard commercial grade of ground mica. Because of the inherent difference in the rubbers employed, the compounding ingredients used with each were different. Using other compounding ingredients, etc., somewhat different results might be obtained. For this reason the compounds employed for each of the different hydrocarbons are not given, but in general it may be said that standard formulae for tire compounding were utilized.

Before referring to the results, the testing apparatus and method will be generally described. The instrument employed was a Cambridge Fabric Permeameter manufactured by the Cambridge Instrument Company, Inc. It is comprised of upper and lower chambers, and a sensitive galvanometer. The test sheets of the material to be tested are sheeted at approximately 0.04 inch gauge. Each sheet is then vulcanized in a mold designed to give a cured circular sheet approximately 0.03 inch thick. The vulcanized test pieces are gauged and their edges waxed. The prepared test samples are then placed between the upper and lower chambers and the apparatus is then closed. The wax material on the edges of the test samples forms a seal. Hydrogen or other gas is admitted to the bottom chamber. The gas diffuses through the test sample into the upper chamber. Integral with the upper chamber is a gas analysis cell which measures the changes in relative concentration of hydrogen or other test gas. This change is measured directly by the galvanometer. The instrument is calibrated to read directly in terms of volume of gas diffused per square meter per 24 hours. The time required to reach a steady state of diffusion depends upon the nature of the vulcanizate to be tested. It is this steady rate of diffusion with which we are concerned and it is the permeability readings taken during this period that were used in compiling the following table.

This table illustrates the value of mica additions to various hydrocarbons. For this comparison, butyl rubber was assigned a diffusion rating of 1.0. The amounts of mica shown in the table are parts by weight per one hundred parts of hydrocarbon. For the test in natural rubber and also in a vulcanizate composed of natural rubber and butyl reclaim (such as is employed as a liner in tubeless tires now on the market) figures are given for compounds containing different amounts of mica.

Hydrocarbon	*Mica*	*Rating*
Butyl	0	1.0
„	40	0.3
Butyl Reclaim	0	1.6
„ „	40	0.5
Natural Rubber and Butyl Reclaim	0	4.9
„ „ „	10	3.8
„ „ „	20	2.8
„ „ „	30	2.4
„ „ „	40	1.7
„ „ „	50	1.6
„ „ „	70	1.4
„ „ „	90	1.0
Neoprene	0	5.4
„	40	1.1
Whole Tire Reclaim ..	0	5.5
„ „ „	40	2.1
GR-S	0	6.1
„	40	1.9
Natural Rubber	0	13.3
„ „	10	11.0
„ „	20	8.4
„ „	30	6.7
„ „	40	5.2
„ „	50	4.1
„ „	70	3.5
„ „	90	2.8

In the table the lower the rating the better is the vulcanizate as an air container. The table is interesting for several reasons. It shows that although butyl rubber has been considered as a very superior lining material, its permeability can be made still lower by the addition of mica. As is illustrated by reference to the figures for natural rubber, both with and without butyl reclaim, the addition of the initial amounts of mica to any vulcanizate has a greater effect in reducing permeability than do succeeding amounts.

A study of the tubless tires now on the market shows that a tire having a liner with a permeability rating of 5.0 or less (using a rating of 1.0 for butyl rubber) is commercially satisfactory. This is obtainable with natural rubber by the addition of mica, even though a natural rubber liner containing no mica is quite permeable to air. Thus, the tubeless tire of this invention may be made with a mica-containing liner of natural rubber. Alternatively, the liner may be GR-S or other rubber vulcanizate and mica.

Tests indicate that the particle size of mica has little or no effect on the permeability. Two samples of water-ground mica representing the range of ordinary commercially available particle sizes were

compounded in natural rubber and tested against natural rubber containing no mica. One sample of the water-ground mica was ground to 160 mesh and the other to 325 mesh. The tests were made as previously described and the results are recorded below.

TABLE II.

Rubber Composition	*Mica*	*Rating*
Natural Rubber	0	16.9
Natural Rubber	40 (160 mesh)	6.3
Natural Rubber	40 (325 mesh)	6.7

The vulcanizate containing the platelets acts as a barrier to the diffusion of air regardless of its location in the tire. In the manufacture of a tire the rubber composition containing the platelet particles ordinarily constitutes the inner wall of the tire. The rubber composition containing the platelet particles may be calendered or otherwise coated onto the cord or square-woven fabric used for the carcass or flippers or other parts of the tire structure.

If used to coat the ends of the cords or the like in a chafer strip of cotton or similar filamentary material, mica-containing rubber stops the chafer strip from wicking the air through the tire. Such chafer strips may be used in tubeless tires with liners which contain no mica such as butyl liners, etc.

The mica is thoroughly mixed with the rubber during the preparation of the rubber composition. When the rubber composition containing the mica is processed either by calendering, spreading or extruding, the platelet particles are striated so that they are substantially parallel with the top and bottom surfaces of the sheet material.

Incorporation of sufficient mica in the rubber to reduce permeability materially alters the physical properties of the vulcanizate. The tensile strength, tear resistance and elongation are decreased, the permanent set is increased, and the cold flexibility is reduced. The degree to which these physical properties are affected depends upon the amount of platelet material employed. Whereas the impairment of the above physical properties by the incorporation of mica may render the vulcanizate unsuitable for most applications, the mica-containing compositions are suitable for use in tubeless tires as described above. The percentage of mica to be employed will vary with the type of rubber used in the composition, and will vary in accordance with the degree of permeability desired.

While mica is the preferred material, aluminum platelet material may also be employed. The platelet materials may be used individually or in mixtures.

The invention will be further described in connection with the accompanying drawings.

In the drawings:—

Fig. 1 is a section through a tubeless tire of this invention;

Fig. 2 is an enlargement within the circle A of Fig. 1, the liner being thicker than ordinarily used in order to adequately illustrate the use of platelets;

Fig. 3 is a plan view of the inside wall taken on line 3—3 of Fig. 2 to illustrate the overlapping of the platelets; and

Fig. 4 shows the location of the chafer strip at the bead of a tire.

The design of the tire 5 of Fig. 1 is illustrative of any pneumatic tire with an open-bellied body terminating in spaced-apart bead portions. This may be a passenger tire, truck tire, or airplane tire, or an off-the-road tire, etc. It is formed with beads 6 of any design and a carcass 7 which may be of any fabric construction and comprise any number of plies. The tread 8 may be designed as desired. It is customary in tubeless tires to employ ribs 10 in the sides of the beads which engage the rim-flange but any means for forming a tight seal between the tire and the rim may be employed.

The liner 15, as illustrated, covers the whole of the open belly of the tire and extends at least to the toes X of the beads. It may extend to the heels Y of the beads and may extend radially outwardly over the rim-flange engaging area on the outer surface of the tire beads, or may fall short of the heels.

Fig. 2 is an enlarged view taken within the circle A of Fig. 1. This shows the liner 15 of rubber containing the striated platelets 18. In both Fig. 2 and Fig. 3 which is a view of the liner from inside of the tire, the dimensions of the platelets 18 are enlarged to facilitate a showing and explanation of the invention. They are aligned parallel to the surfaces of the liner.

In building the tire on a drum this liner material will be placed adjacent the drum surface before locating the fabric plies, beads, etc. It may be calendered to the first fabric ply, or it may be used as a separate ply. Alternatively, it may be applied as a thick solution to the inner surface of the tire. The type of rubber used in the liner 15 may be the same as the adjacent rubber but this is not essential. Regardless of how the rubber containing the platelets is incorporated in the tire, it is vulcanized to the balance of the tire and becomes an integral part thereof.

In Fig. 4, the chafer strip 20 is shown apart from the rest of the tire. When

used in the tire of Fig. 1, it is preferably located outside of the liner 15, to prevent the abrasion of the liner by contact with the rim. If the chafer strip is made of cotton yarn or other filamentary material which wicks the air from within the tire to the outside, such wicking is substantially eliminated by calendering or otherwise coating, and thereby sealing the ends of the cotton cords or the like with a rubber which contains striated platelets.

A tubeless passenger tire provided with a liner of natural rubber 0.04 to 0.08 inch thick and containing 40 parts of mica has been found satisfactory. The thickness of the liner depends upon the nature of the rubber composition, the percentage content of platelet material, the pressure to be used within the tire, etc. With other types of rubber such as those rubbers mentioned in Table I, or a rubber of an entirely different composition, the thickness of the liner might be either reduced or increased. In any event the liner must be of substantial thickness.

In Figs. 2 and 3 the platelets are not drawn to scale. The purpose of the illustration is to show how the platelets are striated and generally overlap, at least to some extent, throughout the thickness of the lining material.

What we claim is:—

1. A tubeless pneumatic tire comprising an open-bellied body terminating in spaced-apart bead portions and including a liner consisting of or including rubber which extends from bead to bead and is vulcanized to the balance of the tire to form an integral part thereof, characterized by mica and/or aluminum platelets distributed throughout the liner, striated and overlapped, and individually surrounded by the rubber in said liner.

2. A tire as claimed in Claim 1, characterized by said body comprising a chafer strip which, uncoated, is capable of wicking air from the inside to the outside of the tire and is coated with vulcanized rubber, said platelets being distributed throughout the coating, one surface of the coated chafer strip being vulcanized to the balance of the tire whereby the chafer strip forms an integral part of the tire.

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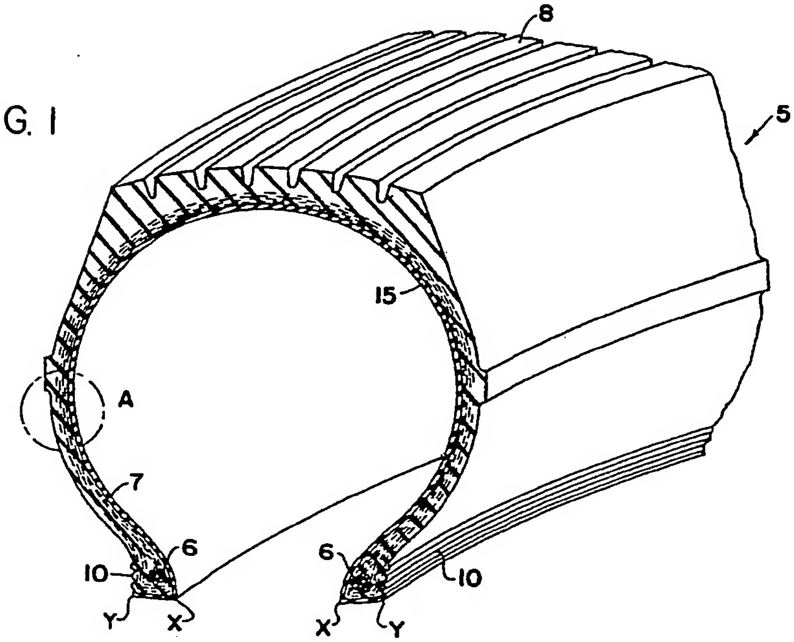
FIG. 1



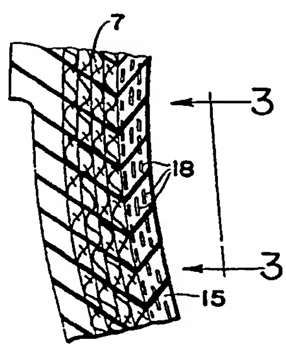


FIG. 2

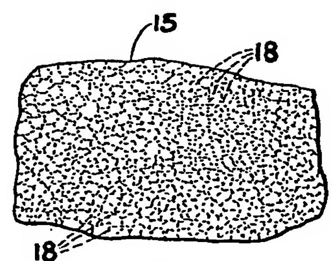


FIG. 3

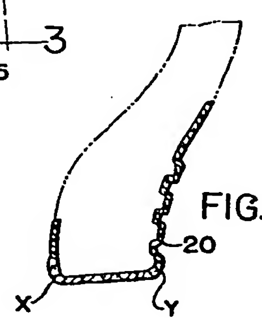


FIG. 4